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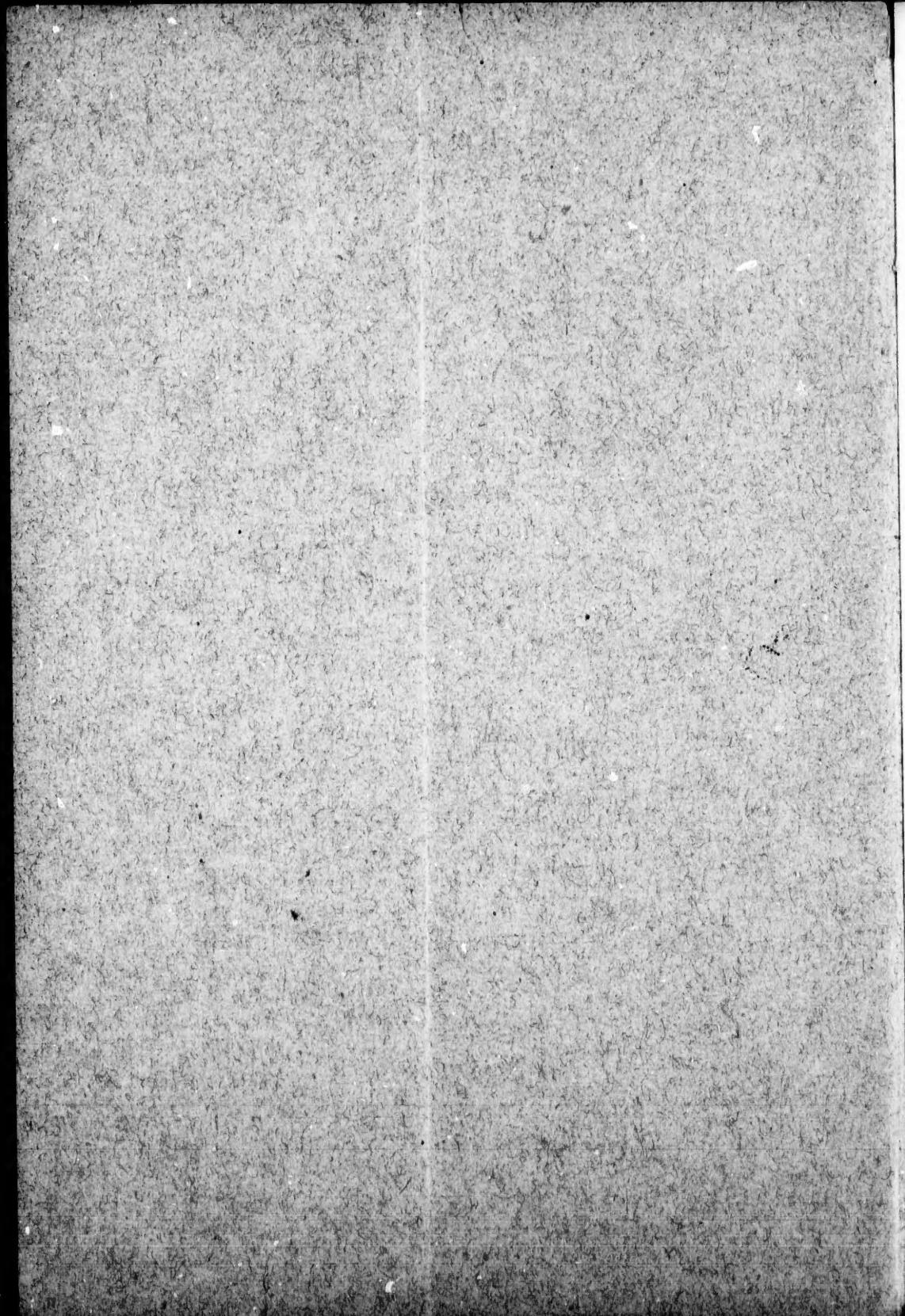
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Preliminary Note on the Limestones of the Laurentian System.

By ELFRIE DREW INGALL.

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Preliminary Note on the Limestones of the Laurentian System.

By **ELFRIC DREW INGALL.**

GEOLOGICAL SURVEY, OTTAWA.

In view of the attention which is now being directed to the above mentioned subject, in connection with the work of the Geological Survey of Canada in the Laurentian area lying north of Ottawa, it is deemed a fitting time to record the observations and conclusions of the writer on the question above denoted.

These observations were made whilst studying the mode of occurrence of the phosphate deposits of the county of Ottawa, Province of Quebec in the years 1888, 1889 and 1890, and have not before been presented to the public owing to the pressure of other duties in connection with the supervision of the division of Mineral Statistics and Mines of the Geological Survey. A fuller and more complete statement of results must even yet await the evidence to be adduced from a microscopical study of the very complete series of rock specimens collected.

At the commencement of the investigation with a view to prevent any prejudice in observation special care was taken to avoid any preconceived theoretical bias and the

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views arrived at are simply the result of an extended and detailed study of the phenomena observable in the field.

Apart from the chief object of the investigation—i.e. the mode of the occurrence of the phosphate deposits—it was intended to show the distribution of the rocks over a typical area which should include the chief mines of the district, and in this way it became necessary to attempt a delimitation of certain limestone areas, in doing which the following features were brought forcibly to light.

Their mode of occurrence was extremely indefinite and irregular. Although great pains were taken it was found impossible in most places to draw any very sharp line between the limestones and the surrounding rocks.

They contained inclusions of gneissic and other associated rocks in the form of bands, nodules, etc.

The proportion of this included rock in relation to the limestone proper was extremely variable so that whilst at some places limestone with inclusions might be a fitting designation, at others one would rather describe as gneiss with intercalated ribbons or bands of calcite. Thus, in passing from a limestone area on to another rock, it became a question of percentage as to where one would draw a line between the two and in the area of gneiss, etc., proper, one would often find little scattering patches of limestone.

These limestone areas show a very constant and more or less definite striping or parallel structure which always maintained a marked parallelism with that of the surrounding gneiss in all its variations of direction.

On close observation, the inclusions in these limestone areas, show some very interesting features. In shape they are varied. One exposure might show a number of contorted bands of gneissic material running parallel to each other, separated by limestone, and much thickened at the sharp bends by doubling. At other places these inclusions form a comparatively small proportion of the rock mass showing as detached nodules, of irregular shape. These nodules are very commonly roughly lenticular, showing a tendency to taper off at either end along the striping of the

enclosing limestone; at places this tapering off is seen, on closer inspection, to be due to strings of particles of felspathic and similar material arranged in line.

All these inclusions of whatever shape seem to have one feature in common. Their exterior surface is hackly, pitted and with a generally corroded appearance.

The general striping of the limestones would seem, on careful study, to be due, either to little irregular chains of such particles or to a different colouring of the replacing calcite crystals, probably marking the places where such particles have been.

The detailed explanation offered by the writer seems to him to satisfactorily and thoroughly explain these and other features of the limestones of the Laurentian. He is led to the conclusion that they simply represent areas of gneissic and similar rocks altered in place into limestones. Furthermore, that the extent and location of these areas have been largely determined by the presence of the abrupt bends and other contortions of these rocks, whose foliae would thus be separated and opened up to the complete action of the subterranean waters. Where such contortions and crumpling of the rocks had extended over a considerable area, the alteration would have gone further and have produced the solid limestone masses so frequently found. In these the inclusions would naturally be scarcer and represent the more solid portions of the ribs of the gneiss which for this reason or owing to their mineral composition were less amenable to change than the rest of the area. These would naturally show the corroded surface already alluded to, and the tapering off along the striping of the rock. The lesser and scattering occurrences of limestone throughout the district, which are a very confusing feature on any other supposition, would thus be satisfactorily accounted for as well as the extreme irregularity of the boundaries of these limestone areas and other phenomena of their occurrence.

Doubtless also the mineral constitution of the original rocks must have been an important factor in the determination of the position, etc., of these alteration areas.

The occurrence of these limestones at the anticlinal folds of the formation has been noticed in a general way by Dr. Ells, of the Geological Survey staff, who is now engaged in mapping the general geology of a very large district north of the Ottawa River, extending from Ottawa city eastward, nearly to Montreal. The writer, however, believes that this is the first attempt to explain *in detail* the reason of this association on the basis of subsequent alteration in place, and to put forward a theory which should harmonize all the features observable both in the larger and more definite areas and in the smaller and scattering patches found throughout the district.

Since writing the above I understand from Dr. Selwyn, the Director of the Geological Survey, that in some correspondence he had with Messrs. Rowney and King in regard to their book on Rock Metamorphism, issued in connection with the Eozoon controversy in 1881, he wrote as follows: "I am led to believe that the two kinds of limestone or dolomite have had a distinct origin and that the non-fossiliferous and generally crystalline set are newer than the strata with which they are associated. Nearly if not quite all our Laurentian and Huronian limestones seem to me to have this non-contemporaneous character notwithstanding that they conform more or less perfectly with the lamination and with the larger flexures of the associated gneiss."

